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SPHERICAL ABERRATION IN ASTRONOMICAL OBJECTIVES DUE TO CHANGES OF TEMPERATURE

By Frank Schlesinger

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Presented to the Academy, November 5, 1914

In September of this year the 30-inch objective for the Thaw Photographic Refractor was installed at the Allegheny Observatory. The objective was made by the John A. Brashear Company of this city. Before it was removed from the optical shop it was tested in a number of ways by the makers and by me. These tests implied an almost perfect figure, and also indicated that the material in the objective is of unusual excellence.

When the objective was first tested at the telescope on actual images of stars, a considerable amount of positive spherical aberration was found to be present; that is, the focal lengths of the outer zones were found to be shorter than for the inner and intermediate zones. The tests were repeated on as many different occasions as possible, with the result that while positive aberration was found to be always present, it varied in amount from night to night and even in the course of a single night. A study of the data thus obtained indicates that the aberration arises from effects of temperature and that it is more pronounced when the temperature is falling rapidly.

To remove this aberration the following expedients were employed. During the day-time, when the telescope is not in use, the objective is enclosed by a metallic cover. With the tube of the telescope this cover acts as a kind of temperature-case, throughout which the temperature is roughly uniform. The observer removes this cover about one hour before beginning to observe in the evening, and at the same time he starts a small electric fan mounted near the upper end of the tube. This fan blows a continuous current of air into the tube through a large vent just below the rear surface of the objective; two similarly placed vents permit the air to escape from the tube. In this way the warmer air that has accumulated during the day is expelled and the rear surface of the objective cools as rapidly as the front. The upper (flint) lens of the objective is separated from the lower (crown) lens by a little less than half an inch. The iron cell in which the two are mounted has been pierced by six holes half an inch in diameter; these permit the air to gain access to the space between the two components.

At the close of the night the observer covers the objective, closes the three vents and inserts cork stoppers in the six lateral holes.

The fan is on the same circuit with the electric lights that illuminate the setting circles of the telescope. As a consequence the fan is in operation at frequent intervals throughout the night. As the lights must be turned off whenever an exposure is being made, the fan is out of operation and cannot cause the tube to vibrate at any time that this could be harmful.

These devices have proved successful in removing the aberrations due to temperature. The Hartmann test has since been applied on a number of occasions and has invariably indicated an excellent figure for the objective.

It is not to be supposed that the Thaw objective is peculiar in its behavior with respect to changes in temperature. An examination of the literature on this subject with regard to other objectives reveals the fact that some of them, at least, are similarly affected and exhibit aberrations that change from time to time, precisely as the Thaw objective did before the application of the ventilating devices. It therefore appears to me that the installation of similar arrangements in the case of other telescopes might bring about a considerable improvement in their performance.

The details of this investigation are to appear in Volume 4 of the Publications of this Observatory.

THE RELATIONS BETWEEN THE PROPER MOTIONS AND THE RADIAL VELOCITIES OF THE STARS OF THE SPECTRAL TYPES F, G, K, AND M

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Among the stars observed for radial velocity with the 60-inch reflector of the Mount Wilson Observatory, there are many of the spectral types *F*, *G*, *K*, and *M* which have either very large or very small astronomical proper motions. The two classes of stars show some very marked differences which indicate a close relationship between proper motion and radial velocity. It is the aim of the present note to bring out this relationship as clearly as possible.

For this purpose it is necessary to supplement the Mount Wilson data for the stars of extreme proper motion with similar data for the rest of the stars. There is, of course, no better source for this purpose than the catalogue of radial velocities published recently by the Lick Observa-